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# Regional, Interim Review of the Status of Northern Shrimp (*Pandalus borealis*) Resources in Areas off Newfoundland and Labrador (Divisions 0B to 3K)

by

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## Abstract

Data from the commercial fishery for northern shrimp were presented for four assessment /management areas: Division 0B, Division 2G, Hopedale + Cartwright Channels and Hawke Channel + Division 3K. Within each area, fishing pattern, catch, effort, catch per unit effort and size/sex composition were reviewed to infer the status of the resource. For Hawke Channel + 3K, results of the 1995/96 multispecies survey pertaining to shrimp also were presented.

With the exception of Division 0B, where the status remains uncertain, the shrimp fisheries performed well in 1995 with catch rates as high as or higher than observed since the fisheries began. Large, female shrimp were well-represented in catches from all areas, indicating a healthy spawning biomass, and high catch rates of smaller, male shrimp indicate good recruitment to the fishery in the short term. Significant catches of Pandalus montagui were reported from Division 2G and, more frequently, from Division 0B.

Based on the favourable review of the 1995 fishery data in comparison to previous years and the extensive area of shrimp abundance evident in the research survey, it was concluded that no decreases in TAC's were required in 1996, the third year of the 1994 - 1996 northern shrimp Management Plan.



## Résumé

Des données concernant la pêche commerciale de la crevette nordique ont été présentées pour quatre aires d'évaluation et de gestion, soit la division 0B, la division 2G, les chenaux Hopedale et Cartwright ainsi que le chenal Hawke et la division 3K. Dans chaque zone, le régime de pêche, les prises, l'effort, les prises par unité d'effort et la composition taille-sexe ont été examinés dans le but d'établir, à partir de ces informations, l'état de la ressource. Pour le chenal Hawke et la division 3K, les résultats du relevé plurispécifique de 1995-1996 concernant la crevette ont également été présentés.

À l'exception de la division 0B, où l'état demeure incertain, les pêches de crevette ont eu un bon rendement en 1995, c'est-à-dire que les taux de prises ont été aussi élevés ou plus élevés que les taux observés depuis le début de l'exploitation de ces pêches. Les crevettes femelles de grande taille se trouvaient en bon nombre dans les prises, dans toutes les zones, ce qui indique une biomasse reproductrice en bon état; en outre, les taux de prises élevés de crevettes mâles plus petites signalent un bon recrutement à court terme. Des prises importantes de *Pandalus montagui* ont été signalées dans la division 2G et, plus souvent encore, dans la division 0B.

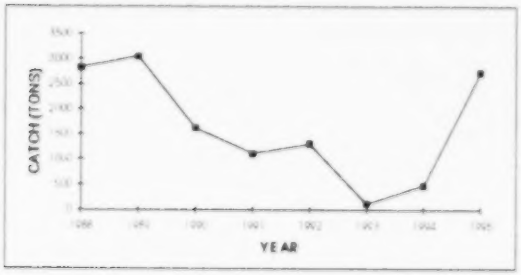
Compte tenu de l'examen favorable des données sur les pêches de 1995, comparativement aux années précédentes, et des vastes superficies où la crevette est en abondance, d'après le relevé de recherche, on a conclu qu'aucune réduction des TAC n'était requise en 1996, soit la troisième année du plan de gestion de la crevette nordique (1994-1996).

# ASSESSMENT OF SHRIMP IN NAFO DIVISION 0B (SFA 2)

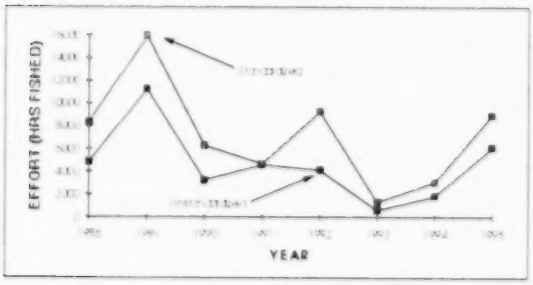
## FISHERY DATA

### Catch and effort

The northern shrimp fishery in Division 0B began in October, 1988. Catches increased from 2800 tons that year to 3039 tons in 1989 but subsequently declined to 106 tons in 1993. Catches increased again to 476 tons in 1994 and 3510 tons in 1995. The 1995 catch estimate is preliminary and likely inflated by the inclusion of catches of *Pandalus montagui* from the area east of Resolution Island. The catch estimate used here is based on vessel logbook data which indicated about 60% *P. borealis* by weight. Although this percentage was similar to that obtained from observer records, the final figures are not yet available.



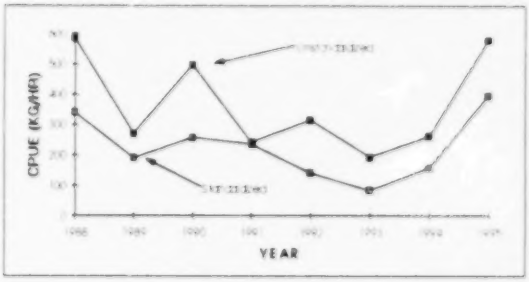

Effort about doubled from 1988 to 1989 but then decreased up to 1993. There was a substantial increase in effort from 1993 to 1995.




In 1988, the fishery occurred north of 64° N with occasional tows near 66° N (Fig. 1). Effort in 1989 was concentrated between 64° and 65° N but extended as far south as 62° N. More effort was distributed south of 64° N in subsequent years. The areas fished in 1995 reflect the targeting of *P. montagui* east of Resolution Island and a return to northern grounds near 65° 30' N.

### Catch per unit effort (CPUE)

Unstandardized, annual CPUE's decreased from 585 kg/hr in 1988 to 271 in 1989 and increased to 497 in 1990. Catch rates decreased during 1991 - 1994 to the 200-300 kg/hr range but increased to 579 kg/hr in 1995. The data were analyzed by multiple regression for year and vessel effects. The model showed that the standardized, 1995 catch rate of 395 kg/hr was significantly higher ($P < 0.05$) than those in five of the previous six years and similar to the 1988 estimate ($P = 0.69$). Both series showed an overall declining trend to 1993 and an increase, thereafter.




Historical fishery data for this management-assessment area are summarized in Table 1.

### Size composition

Catches in most years were composed primarily of large, female shrimp (Fig. 2) with a modal length of about 27 mm carapace

length (CL). Occurrence of higher proportions of the male component (<25 mm) after 1988 was coincident with the southward shift in fishing effort. The sampling data showed that the occurrence of smaller/younger male shrimp (i.e. < 22 mm) declined from 1990 to 1993 but increased thereafter. In 1994, catches comprised mostly large males (23 - 24 mm) and females whereas, in 1995, the female component (27 mm) was dominant.

## RESOURCE STATUS/PERSPECTIVES

This area is difficult to fish due to the presence of ice and/or the apparent sudden shifts in water masses that are believed by fishermen to affect shrimp distribution. They have observed that shrimp concentrations throughout the area are elusive. This contrasts the situation in several southern locations where areas of high concentration support substantial levels of effort and CPUE, and persist from year to year.

The status of this resource remains uncertain. The CPUE and sampling data are not considered to be reliable indices of stock conditions. The fluctuations in both catch and catch rates are more likely a reflection of the degree of difficulty in locating concentrations of shrimp than they are indicators of significant changes in the resource abundance. High catch rates still occur sporadically throughout the Division and, in 1995, were frequently encountered in the southwest, just east of Resolution Island in a *P. borealis/montagui* mixture.

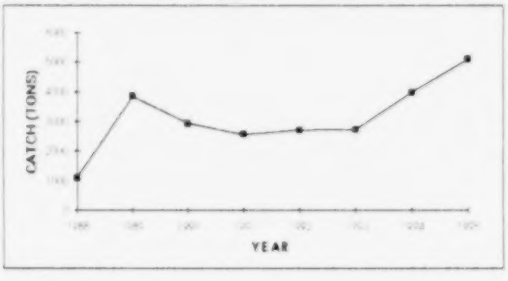
There is no basis on which to advise a change in the 1994 - 1996 Management Plan which set the TAC at 3500 tons. This level was established in 1989 as a precautionary level in an exploratory area and is still considered in this context. The occurrence of *P. montagui* in the 1995 catches, however, does have implications for management of that species around Resolution Island (SFA's 2, 3 and 4) in 1996 .

# ASSESSMENT OF SHRIMP IN NAFO DIVISION 2G (SFA 4)

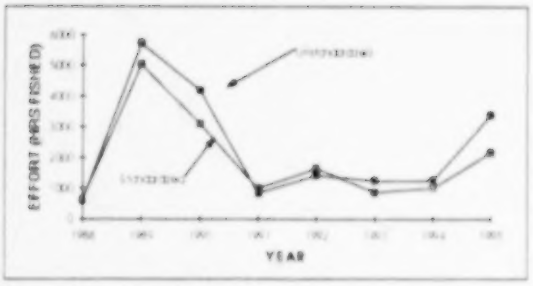
## FISHERY DATA

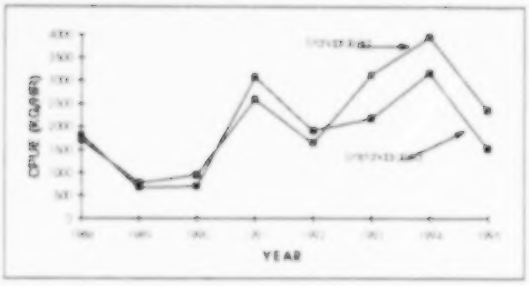
### Catch and effort

The northern shrimp fishery in Division 2G began in 1988, only incidental catch and effort having been reported from previous years. Catches increased from 1083 tons in 1988 to 3842 tons in 1989 and remained within the 2500 - 3000 ton range up to 1993. The 1994 catch increased to 3982 tons with an increase in TAC to 4000 tons in the first year of the 1994 - 1996 Management Plan. A second, planned increase in the TAC, to 5200 tons in 1995, resulted in a catch of 5104 tons.




Fishing effort increased substantially from 1988 to 1989, decreased to 1991 and remained relatively stable up to 1994 before increasing again in 1995.




From 1988 to 1990, the fishery occurred throughout the Division which, during that period, was split into two management zones, north and south of 60° N. The 1991 - 1993 Management Plan combined the two zones and, since then, effort has concentrated in the north (Fig. 3). Some substantial by-catches of *P. montagui* were encountered for the first time in 1995, primarily in shallower water.

**Catch per unit effort (CPUE)**

The area is noted for producing high catch rates of large shrimp, especially north of 60° N. Unstandardized, annual CPUE's declined from 1823 kg/hr in 1988 to about 700 in 1989 and 1990. In 1991, catch rate increased substantially to over 3000 kg/hr as fishing effort concentrated in the northern grounds. High CPUE's in the range of 2000 to 3000 kg/hr were maintained up to 1994. The 1995 catch rate declined to 1500 kg/hr.

The CPUE data were analyzed by multiple regression for year, month and vessel effects. The model showed that the annual, standardized catch rate for 1995 was only significantly lower than the 1994 rate ($P < 0.05$) and significantly higher than the 1989, 1990 and 1992 estimates. The 1988, 1991 and 1993 estimates were similar to the 1995 value ($P > 0.25$). Both series showed an overall increase from 1989/90 to 1994, followed by a decrease in 1995.

Historical fishery data for this management-assessment area are summarized in Table 2.

**Size composition**

Catch-at-length data showed highly variable size distributions between years (Fig. 2). High proportions of male shrimp (< 25 mm CL) and overall lower catch rates in 1989 and 1990 reflect the fishing activity south of 60° N in those years. Large, female shrimp dominated in 1991 when effort shifted to the northern grounds. The strong component of males observed in the 1992 catches recruited further to the fishery in 1993, occurring as larger males and small females and possibly explaining the increase in CPUE between the two years and the higher proportion of females in the latter. The reduction in the proportion and number of males caught per hour in 1993 compared to 1992 did not negatively impact catch rates in 1994. The female component continued to support high CPUE's in both 1994 and 1995, indicating that a healthy spawning biomass is being maintained.

**RESOURCE STATUS/ PERSPECTIVES**

The continued occurrence high densities of large shrimp in the northern grounds will likely attract most of the effort to that area, with little or no fishing south of 60° N. Conversations with a few vessel captains about

the decline in catch rates in 1995 revealed that this might be more a reflection of their attempts to minimize the count per kg and avoid by-catch of *P. montagui*, rather than a signal of declining abundance. High densities of both smaller *P. borealis* and *P. montagui*, encountered in shallower depths in 1995, generally were avoided by the fishermen.

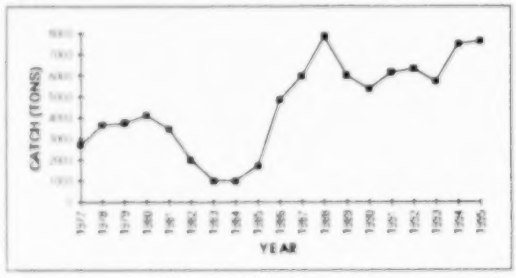
The continuation of high proportions of large, female shrimp indicates a healthy spawning biomass is being maintained. The lower catch rate in 1995, although of some concern, still compares favourably with those of most other years. In 1994, the TAC previously set at 2700 tons for the 1991 - 1993 period was viewed as overly restrictive to the fleet and, although there was no quantitative basis on which to advise a higher catch level, it was suggested that the TAC be increased experimentally to about 5000 tons. Industry chose to implement the proposed increase over two years - an initial increase to 4000 tons in 1994, the first year of the multi-year management plan, and a further increase to 5200 tons in 1995. The latter should be maintained for 1996 and the effects on the resource closely monitored.

## ASSESSMENT OF SHRIMP IN HOPEDALE & CARTWRIGHT CHANNELS (SFA 5)

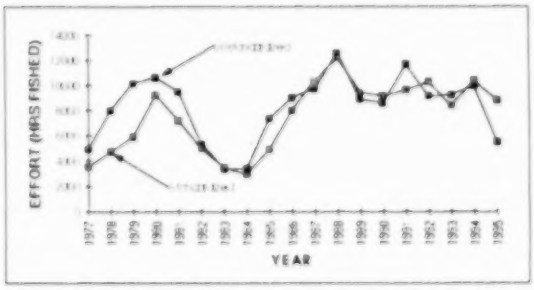
### FISHERY DATA

#### Catch and effort

The northern shrimp fishery in Hopedale and Cartwright Channels began in 1977, following experimental fishing in the previous two years. Catches increased from about 2700 tons in 1977 to 4100 tons in 1980, declined to 1000 tons in 1983 and 1984, increased again to 7800 tons in 1988 and then stabilized at roughly 6000 tons during the 1989 - 1993 period. The TAC's for the 1994 - 1996 Management Plan, which combined the two channels as a single management area, were increased by 20% to 7650 tons annually and catches subsequently increased to 7499 tons in 1994 and 7616 tons in 1995. Since the implementation of the plan in 1994, the proportion of the annual catch taken near Cartwright Channel, in the south, has increased from about 25% during the 1991 - 1993 period to 42% in 1994 and 78% in 1995. To date in 1996, about 6000 tons already have been taken, mostly from the Cartwright Channel area.




Fishing effort showed approximately the same trends over time as catch. In recent years, however, effort has either stabilized or decreased while catches have increased slightly.



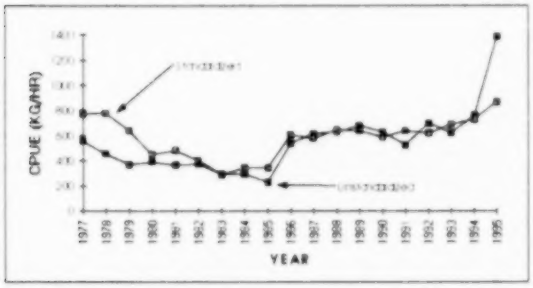
Traditionally, effort has concentrated in four main areas: northern, eastern and southern Hopedale Channel and Cartwright Channel (Fig. 4). In the 1990's, however, more effort was reported from the slopes of the shelf - north and east of Cartwright Channel. In both 1994 and especially 1995, substantial effort occurred on the eastern slope during winter and spring. The same fishing pattern has emerged, to date, in 1996.

Historically, a summer - fall fishery, this has become mainly a winter - spring operation in 1995 and 1996.

**Catch per unit effort (CPUE)**

Unstandardized, annual CPUE's declined from 552 kg/hr in 1977 to 230 in 1985, increased substantially in 1986 and stabilized around a mean level of 615 kg/hr during the 1986 - 1993 period. Catch rates increased, thereafter, to 757 kg/hr in 1994 and 1385 kg/hr in 1995.

The CPUE data were further analyzed by multiple regression for year, month, vessel and area effects. The standardized 1995 catch rate of 867 kg/hr was the highest in the time series and was significantly higher ($P < 0.05$) than the estimates in all but the first three years of the fishery. Both series show approximately the same trend - a decline to the mid 1980's, a substantial increase in 1986 followed by stability to the early 1990's and an increase since then.




Historical fishery data for this management-assessment area are summarized in Table 3.

**Size composition**

Catch-at-length data from 1988 to 1995 (Fig. 2) showed a modal group of females at 24 - 25 mm CL occurring each year. Recruitment of males at ages 4, 5 and 6 (approx. 16 - 23 mm) has been consistent from year to year and males have contributed substantially to the catch in numbers. The 1994 and 1995 data suggest that year classes produced in the late 1980's and early 1990's will maintain high catch rates for the next few years.

**RESOURCE STATUS/PERSPECTIVES**

The northern shrimp resource in the Hopedale and Cartwright Channels remains healthy with commercial catch rates stable over the late 1980's and increasing in recent years. No declining trend in the proportions or catch rates of female shrimp has emerged and prospects for recruitment to the female component in the near future are favourable.

Preliminary data from daily vessel hails show that the 1996 fishery performed well from January to March, with monthly catch rates (unstandardized) exceeding those for the same months in 1995.

The impact of fishing, although not yet quantified, appears minimal. The presence of refuge areas in waters both shallower and deeper than the fishing grounds also affords some protection for males and females, respectively. Given the current, positive view of the status of the resource, no reduction in the TAC is required for the final year of the 1994 - 1996 Management Plan.

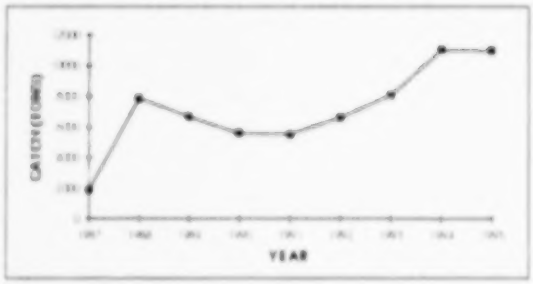
Combining the two channels as a single management/assessment area in 1994 has resulted in substantially higher catches from the Cartwright Channel area in 1994, 1995 and 1996 compared to previous years. Despite the increases in both catch and effort, CPUE (unstandardized) from the Cartwright area in 1995 was over 80% higher than the 1994 rate and, as noted above, the early 1996 fishery has performed extremely well.

## ASSESSMENT OF SHRIMP IN HAWKE CHANNEL + DIV. 3K (SFA 6)

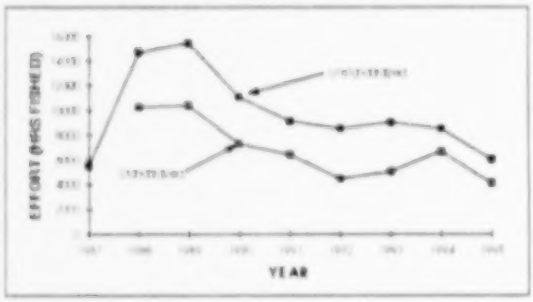
### FISHERY DATA

#### Catch and effort

The shrimp fishery in Hawke Channel + Division 3K began in 1987 when 1845 tons were caught. Previously, only a few tons had been reported from Hawke Channel in some years. Catches increased to more than 7800 tons in 1988 and ranged between 5500 and 8000 tons from 1989 to 1993, inclusive. The annual TAC for the 1994 - 1996 Management Plan was set at 11,050 tons (20% more than the 1993 TAC) to include Hawke Channel, St. Anthony Basin, east St. Anthony, Funk Island Deep as well as three exploratory areas on the seaward slope of the shelf. Catches increased to 10,978 tons in 1994 and 10,914 tons in 1995. Logbook data show that more than 75% of the catch in both years was taken from the Hawke Channel area.




Fishing effort declined from 1989 to 1992, stabilized or increased slightly to 1994 and declined noticeably from 1994 to 1995. The fishery occurs, primarily, during the first five months of the year.

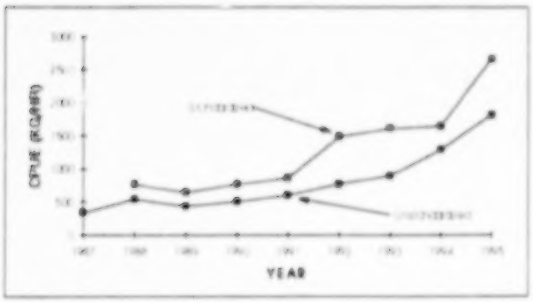



A displacement of fishing effort to the east occurred after 1991 due to several factors: the establishment of exploratory areas on the shelf slope in 1992 and 1993, the discovery of concentrations of shrimp in these areas, the occurrence of ice in winter and spring each year and the flexibility to fish recent TAC's anywhere within the large management area. This displacement was particularly evident in St. Anthony Basin where both catch and effort declined markedly since 1992 (Fig. 5).

#### Catch per unit effort (CPUE)

Unstandardized, annual CPUE's decreased from 536 kg/hr in 1988 to 432 in 1989 and increased steadily thereafter to 1816 kg/hr in 1995. The CPUE data also were analyzed by

multiple regression for year, month, vessel and area effects to standardize the catch rates. Standardized values revealed approximately the same overall increasing trend as the unstandardized series. However, the 1992 to 1994 standardized rates were relatively stable whereas the raw data indicated a continual increase.




Despite the high catches from Hawke Channel in 1994 and 1995 compared to previous years, catch rates from that area alone continued to increase. The 1996 fishery, to date, has also concentrated in the Hawke Channel area and catch rates for the January - April period remained at the 1995 level.

Historical fishery data for this management-assessment area are summarized in Table 4.

### Size composition

Catch-at-length data from 1988 to 1995 showed dominance of the female component around 24 mm CL in most years (Fig. 2). The increase in catch rates following 1989 was likely due to recruitment of at least two strong year classes which first appeared (as males) in 1990. Substantial proportions and catch rates of male shrimp (16 - 22 mm) evident since 1993 suggest continued good recruitment. The relatively strong size group at 16.5 mm in 1994 (the 1991 year class) dominated the male component at 18.5 mm in 1995. Although partly obscured by the 1991 year class, the 1992 year class also appears strong in 1995.

## RESEARCH SURVEY DATA

The fall/winter groundfish survey of 1995/96 was conducted with a small-meshed Campelen trawl, providing excellent data on distribution and abundance of shrimp throughout the survey area (Div. 2J3KLNO). Shrimp were widely distributed within this assessment-management area with largest catches (>100 kg/tow) occurring in Hawke Channel and the northernmost parts of Div. 3K (Fig. 6). Sampling data indicated that most of the abundance was due to male shrimp.

## RESOURCE STATUS/PERSPECTIVES

The northern shrimp resource in Hawke Channel + Division 3K remains healthy and catch rate data suggest that abundance has increased in recent years. The eastward displacement of the fishery after 1991 and the concentration of effort near Hawke Channel are more a reflection of the flexibility in the choice of fishing area than a change in shrimp distribution. Areas to the west, although fished less intensively after 1992, continue to produce high catch rates. Furthermore, the proportion of female shrimp in the commercial catches remains high and there are no signs of weak recruitment for the near future from either research or commercial fishery data.

Given the evidence for increased abundance, low exploitation, a healthy spawning biomass and prospects for good recruitment to the fishery in the short term, no reduction in the TAC is required for the final year of the 1994 - 1996 Management Plan.

The increased commercial catches from the Hawke Channel area in 1994 and 1995 have had no negative effects on catch rates, and survey catches in late 1995 and early 1996 were high throughout the area. Also, catch rates in the first four months of the 1996 fishery were comparable to those of 1995. Therefore, the changing fishing pattern, due to the combination of Hawke Channel and Div. 3K as a single assessment-management area, has had no detectable negative effects on the resource, as yet, but still should be closely monitored for signs of localized depletion.

TABLE 1. NORTHERN SHRIMP FISHERY DATA FOR DIV. 0B, 1988 - 1995.

| | | | UNSTANDARDIZED | | | STANDARDIZED | | |
|---|---|---|---|---|---|---|---|---|
| YEAR | TAC[1] (t) | CA /CH[2] (t) | CPUE (KG/HR) | INDEX | EFFORT[3] (HR) | CPUE (KG/HR) | INDEX | EFFORT[3] (HR) |
| 1988 | | 2826 | 585 | 1.00 | 4831 | 340 | 1.00 | 8312 |
| 1989 | 3500 | 3039 | 271 | 0.46 | 11214 | 191 | 0.56 | 15911 |
| 1990 | 3500 | 1609 | 497 | 0.85 | 3237 | 257 | 0.76 | 6261 |
| 1991 | 3485 | 1107 | 242 | 0.41 | 4574 | 237 | 0.70 | 4671 |
| 1992 | 3485 | 1291 | 315 | 0.54 | 4098 | 140 | 0.41 | 9221 |
| 1993 | 3485 | 106 | 193 | 0.33 | 549 | 82 | 0.24 | 1293 |
| 1994 | 3500 | 476 | 262 | 0.45 | 1817 | 157 | 0.46 | 3032 |
| 1995 | 3500 | 3510 | 579 | 0.99 | 6062 | 395 | 1.16 | 8886 |

[1] TAC'S FOR 1989 AND 1990 ARE FOR THE FISHING SEASON MAY 1 TO APRIL 30 AND FOR THE CALENDAR YEAR, THEREAFTER, MAKING 1991 AN 8 MONTH YEAR (MAY 1 - DEC. 31)

[2] CATCH (TONS) FOR 1988 AND 1989 AS REPORTED IN ECONOMIC ASSESSMENT OF THE NORTHERN SHRIMP FISHERY AND FROM YEAR-END QUOTA REPORTS AND/OR LOGBOOK RECORDS, THEREAFTER.

[3] EFFORT CALCULATED FROM CATCH/CPUE. CPUE CALCULATED FROM VESSEL LOG DATA.

TABLE 2. NORTHERN SHRIMP FISHERY DATA FOR DIV. 2G, 1979 - 1995.

| | | | UNSTANDARDIZED | | | STANDARDIZED | | |
|---|---|---|---|---|---|---|---|---|
| YEAR | TAC[1] (t) | CATCH[2] (t) | CPUE (KG/HR) | INDEX | EFFORT[3] (HR) | CPUE (KG/HR) | INDEX | EFFORT[3] (HR) |
| 1979 | 500 | 3 | 823 | | 4 | | | |
| 1980 | 500 | <1 | 6 | | 8 | | | |
| 1981 | 500 | 2 | 381 | | 5 | | | |
| 1982 | 500 | 5 | 252 | | 20 | | | |
| 1983 | 500 | 30 | 441 | | 68 | | | |
| 1986 | 500 | 2 | 450 | | 4 | | | |
| 1987 | 500 | 7 | 303 | | 23 | | | |
| 1988 | 500 | 1083 | 1823 | 1.00 | 594 | 1718 | 1.00 | 630 |
| 1989 | 2580 | 3842 | 672 | 0.37 | 5717 | 763 | 0.44 | 5035 |
| 1990 | 2580 | 2945 | 703 | 0.39 | 4189 | 947 | 0.55 | 3110 |
| 1991 | 2635 | 2561 | 3078 | 1.69 | 832 | 2600 | 1.51 | 985 |
| 1992 | 2635 | 2706 | 1910 | 1.05 | 1417 | 1641 | 0.96 | 1649 |
| 1993 | 2735 | 2723 | 2174 | 1.19 | 1253 | 3127 | 1.82 | 871 |
| 1994 | 4000 | 3982 | 3169 | 1.74 | 1257 | 3950 | 2.30 | 1008 |
| 1995 | 5200 | 5104 | 1507 | 0.83 | 3387 | 2349 | 1.37 | 2173 |

[1] TAC'S FROM 1987 TO 1990, INCLUSIVE ARE FOR THE FISHING SEASON MAY 1 TO APRIL 30, MAKING 1986 A 16 MONTH YEAR (JAN.1, 1986 - APRIL 30, 1987) AND 1991 AN 8 MONTH YEAR (MAY 1 - DEC. 31).

[2] CATCH (TONS) AS REPORTED IN: LOGBOOKS FOR 1979, ECONOMIC ASSESSMENT OF THE NORTHERN SHRIMP FISHERY FROM 1980 TO 1989 AND FROM YEAR-END QUOTA REPORTS AND/OR LOGBOOKS, THEREAFTER.

[3] EFFORT CALCULATED FROM CATCH/CPUE. CPUE CALCULATED FROM VESSEL LOG DATA.

TABLE 3. NORTHERN SHRIMP FISHERY DATA FOR HOPEDALE AND CARTWRIGHT CHANNELS, 1977 - 1995.

| | | | UNSTANDARDIZED | | | STANDARDIZED | | |
|---|---|---|---|---|---|---|---|---|
| YEAR | TAC[1] (t) | CATCH[2] (t) | CPUE (KG/HR) | INDEX | EFFORT[3] (HR) | CPUE (KG/HR) | INDEX | EFFORT[3] (HR) |
| 1977 | . | 2686 | 552 | 1.00 | 4866 | 768 | 1.00 | 3497 |
| 1978 | 5300 | 3630 | 453 | 0.82 | 8013 | 773 | 1.01 | 4696 |
| 1979 | 4000 | 3727 | 368 | 0.67 | 10128 | 634 | 0.83 | 5879 |
| 1980 | 4800 | 4108 | 388 | 0.70 | 10588 | 446 | 0.58 | 9211 |
| 1981 | 4800 | 3449 | 364 | 0.66 | 9475 | 480 | 0.63 | 7185 |
| 1982 | 4800 | 1983 | 372 | 0.67 | 5331 | 399 | 0.52 | 4970 |
| 1983 | 4800 | 1000 | 297 | 0.54 | 3367 | 289 | 0.38 | 3460 |
| 1984 | 4200 | 1002 | 297 | 0.54 | 3374 | 341 | 0.44 | 2938 |
| 1985 | 3570 | 1689 | 230 | 0.42 | 7343 | 346 | 0.45 | 4882 |
| 1986 | 4400 | 4826 | 538 | 0.97 | 8970 | 602 | 0.78 | 8017 |
| 1987 | 4800 | 5956 | 613 | 1.11 | 9716 | 578 | 0.75 | 10304 |
| 1988 | 4800 | 7838 | 625 | 1.13 | 12541 | 644 | 0.84 | 12171 |
| 1989 | 6000 | 5985 | 677 | 1.23 | 8840 | 637 | 0.83 | 9396 |
| 1990 | 6000 | 5360 | 626 | 1.13 | 8562 | 586 | 0.76 | 9147 |
| 1991 | 6375 | 6118 | 526 | 0.95 | 11631 | 638 | 0.83 | 9589 |
| 1992 | 6375 | 6315 | 695 | 1.26 | 9086 | 618 | 0.80 | 10218 |
| 1993 | 6375 | 5719 | 622 | 1.13 | 9195 | 685 | 0.89 | 8349 |
| 1994 | 7650 | 7499 | 757 | 1.37 | 9906 | 727 | 0.95 | 10315 |
| 1995 | 7650 | 7616 | 1385 | 2.51 | 5499 | 867 | 1.13 | 8784 |

[1] TAC'S FROM 1987 TO 1990, INCLUSIVE ARE FOR THE FISHING SEASON MAY 1 TO APRIL 30, MAKING 1986 A 16 MONTH YEAR (JAN.1, 1986 - APRIL 30, 1987) AND 1991 AN 8 MONTH YEAR (MAY 1 - DEC. 31).

[2] CATCH (TONS) IN CALENDAR YEAR AS REPORTED IN : LOG BOOKS FOR 1977, ECONOMIC ASSESSMENT OF THE NORTHERN SHRIMP FISHERY FROM 1978 TO 1989 AND YEAR-END QUOTA REPORTS, THEREAFTER.

[3] EFFORT CALCULATED FROM CATCH/CPUE. CPUE CALCULATED FROM VESSEL LOG DATA.

TABLE 4. NORTHERN SHRIMP FISHERY DATA FOR HAWKE CHANNEL + DIVISION 3K, 1977 - 1995.

| | | | UNSTANDARDIZED | | | STANDARDIZED | | |
|---|---|---|---|---|---|---|---|---|
| YEAR | TAC[1] (t) | CATCH[2] (t) | CPUE (KG/HR) | INDEX | EFFORT[3] (HR) | CPUE (KG/HR) | INDEX | EFFORT[3] (HR) |
| 1977 | | 1 | 117 | | 6 | | | |
| 1978 | 1300 | | | | | | | |
| 1979 | 2250 | 5 | 189 | | 29 | | | |
| 1980 | 1350 | | | | | | | |
| 1981 | 1350 | 135 | 207 | | 652 | | | |
| 1982 | 1350 | 1 | 151 | | 3 | | | |
| 1983 | 1350 | | | | | | | |
| 1984 | 1350 | | | | | | | |
| 1985 | 1350 | | | | | | | |
| 1986 | 2050 | | | | | | | |
| 1987 | 3000 | 1845 | 333 | | 5541 | | | |
| 1988 | 3000 | 7849 | 536 | 1.00 | 14644 | 767 | 1.00 | 10233 |
| 1989 | 5600 | 6662 | 432 | 0.81 | 15421 | 641 | 0.84 | 10393 |
| 1990 | 5600 | 5598 | 507 | 0.95 | 11041 | 767 | 1.00 | 7299 |
| 1991 | 4301 | 5500 | 603 | 1.13 | 9121 | 863 | 1.13 | 6373 |
| 1992 | 7565 | 6609 | 774 | 1.44 | 8539 | 1485 | 1.94 | 4451 |
| 1993 | 9180 | 8035 | 891 | 1.66 | 9018 | 1609 | 2.10 | 4994 |
| 1994 | 11050 | 10978 | 1287 | 2.40 | 8530 | 1642 | 2.14 | 6686 |
| 1995 | 11050 | 10914 | 1816 | 3.39 | 6010 | 2666 | 3.48 | 4094 |

[1] HISTORICAL TAC'S APPLIED AS FOLLOWS:

1978 TO 1985 - INCLUDES 500 TON EXPLORATORY TAC FOR DIVISION 3K;
1986 TO 1988 - HAWKE CHANNEL + ST. ANTHONY BASIN;
1989 TO 1991 - HAWKE CHANNEL, ST. ANTHONY BASIN, EAST ST. ANTHONY AND FUNK ISLAND DEEP;
1992 - INCLUDES 1700 TONS EXPLORATORY;
1993 - INCLUDES 3400 TONS EXPLORATORY;
1994 and 1995 - ALL AREAS COMBINED.

TAC'S FROM 1987 TO 1990, INCLUSIVE, ARE FOR THE FISHING SEASON MAY 1 TO APRIL 30, MAKING 1986 A 16 MONTH YEAR (JAN.1, 1986 - APRIL 30, 1987) AND 1991 AN 8 MONTH YEAR (MAY 1 - DEC. 31).

[2] CATCH (TONS) IN CALENDAR YEAR AS REPORTED IN: LOG BOOKS FOR 1977, ECONOMIC ASSESSMENT OF THE NORTHERN SHRIMP FISHERY FROM 1978 TO 1989 AND YEAR-END QUOTA REPORTS, THEREAFTER.

[3] EFFORT CALCULATED FROM CATCH/CPUE. CPUE CALCULATED FROM VESSEL LOG DATA.

Fig. 1. Distribution of fishing effort in Div. 0B (SFA 2), 1988-95.

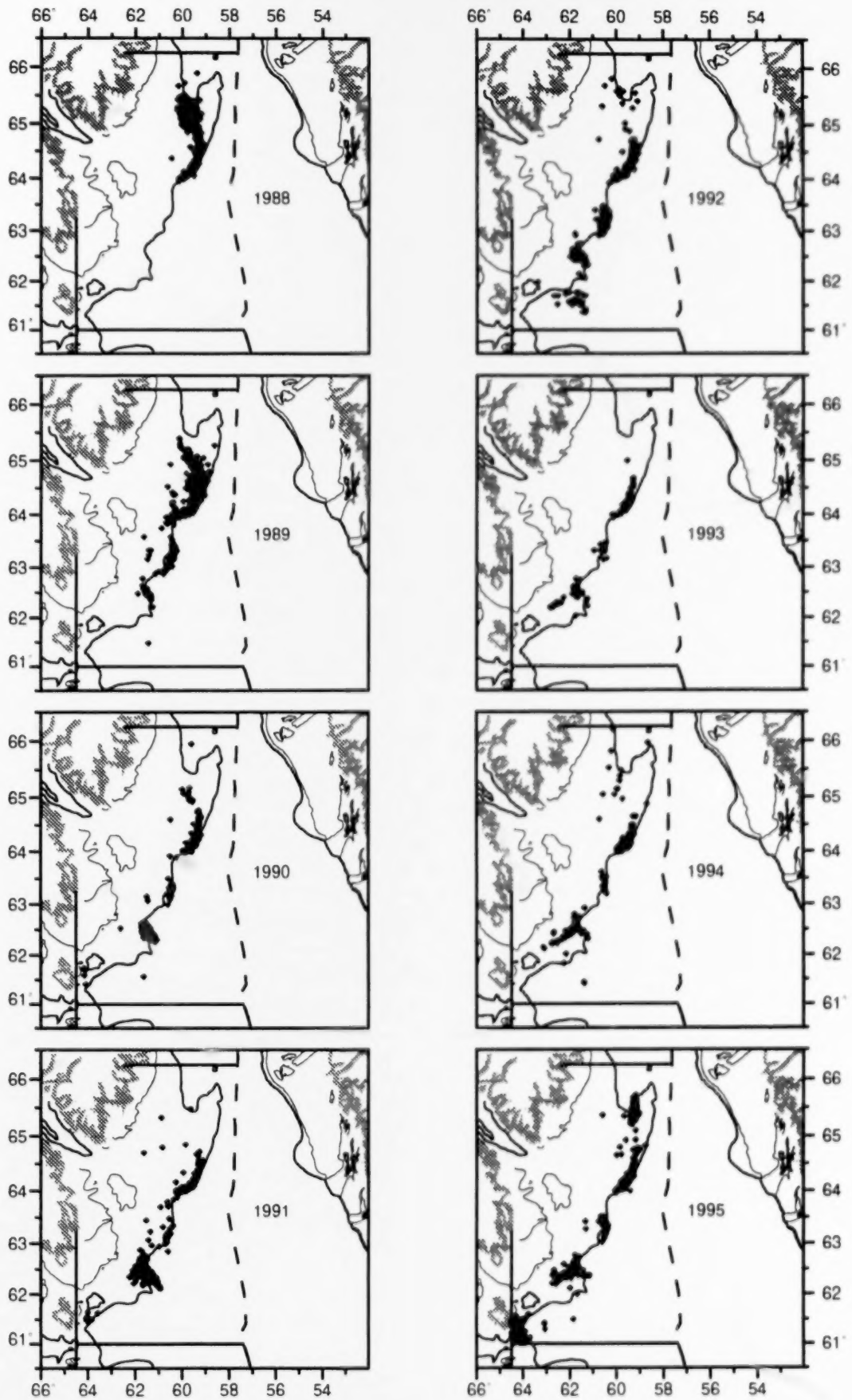


Fig. 2. Catch (numbers-per-hour..000's) in NAFO Divisions 0B - 3K, 1988-95.

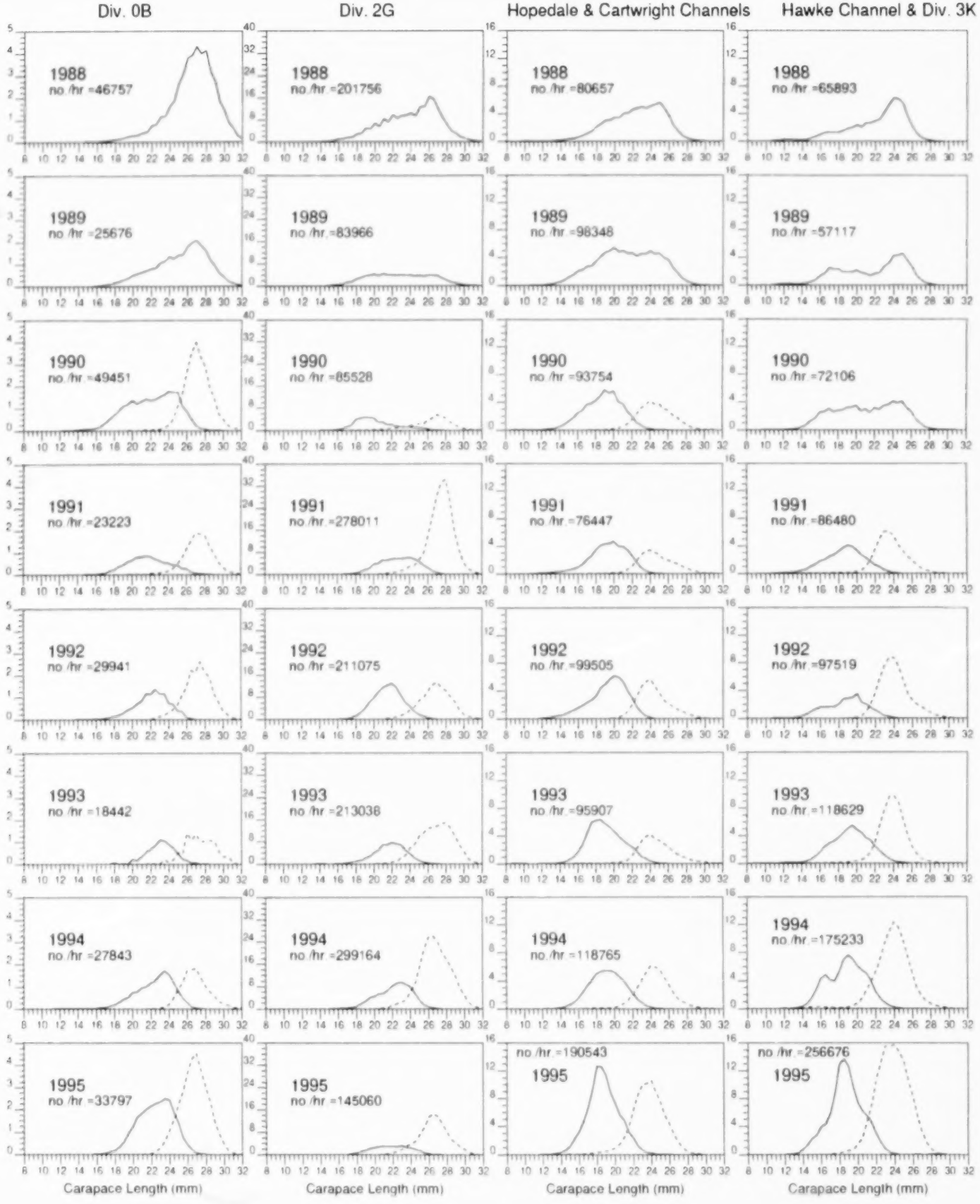


Fig. 3. Distribution of fishing effort in Div. 2G (SFA 4), 1988-95.

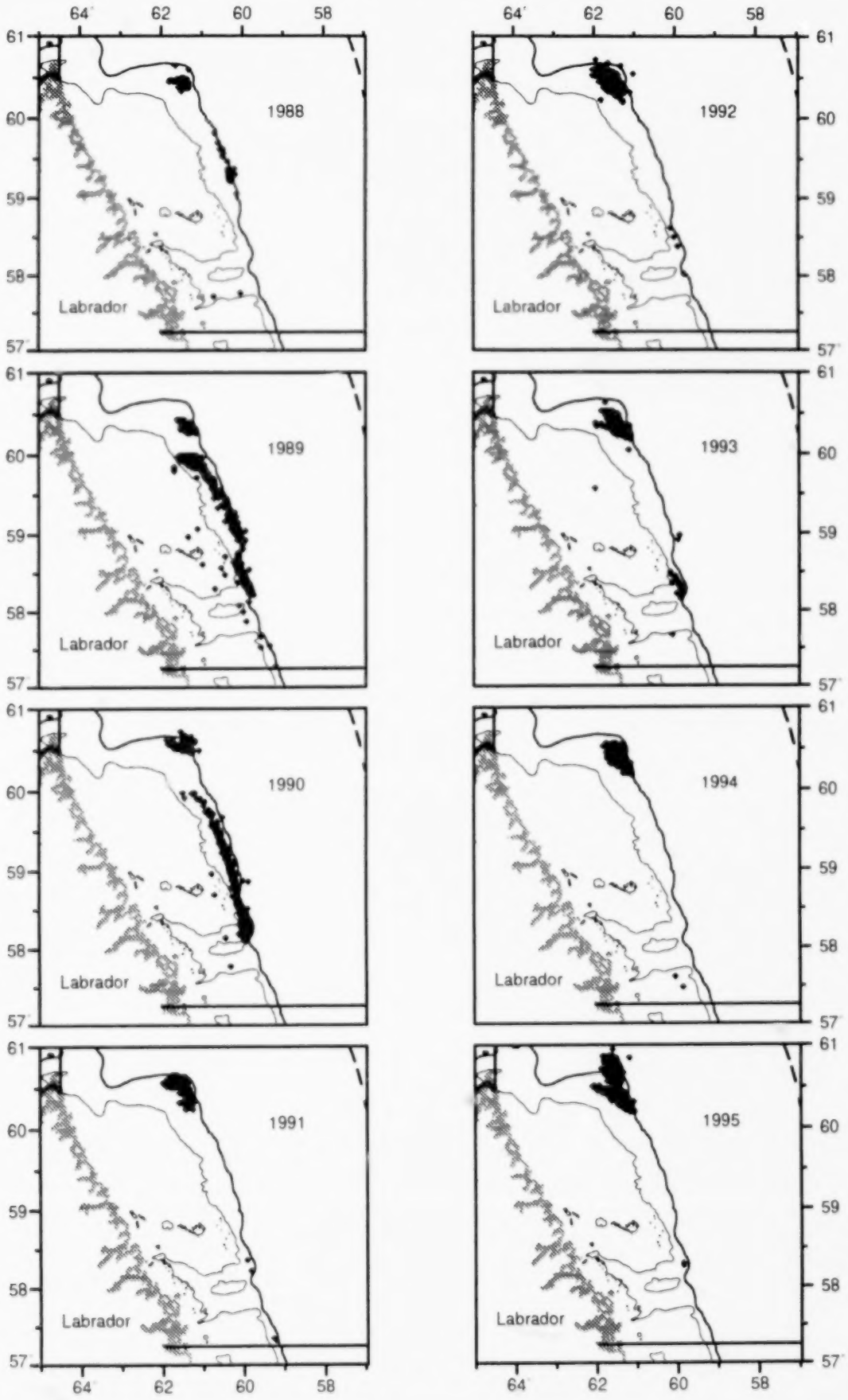


Fig. 4. Distribution of fishing effort in Hopedale and Cartwright Channels (SFA 5), 1988-95.

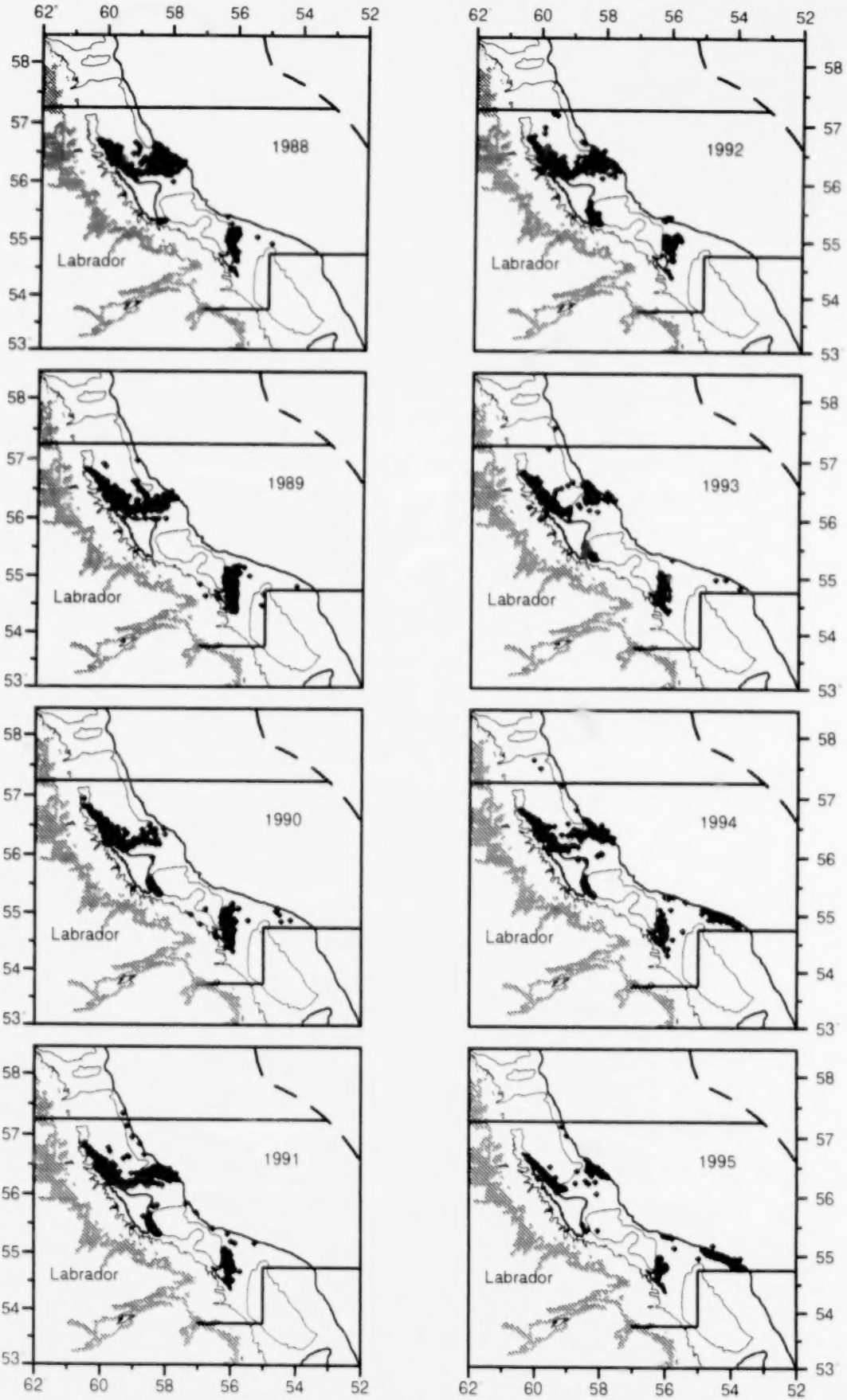


Fig. 5. Distribution of fishing effort in Hawke Channel and Div. 3K (SFA 6), 1988-95.

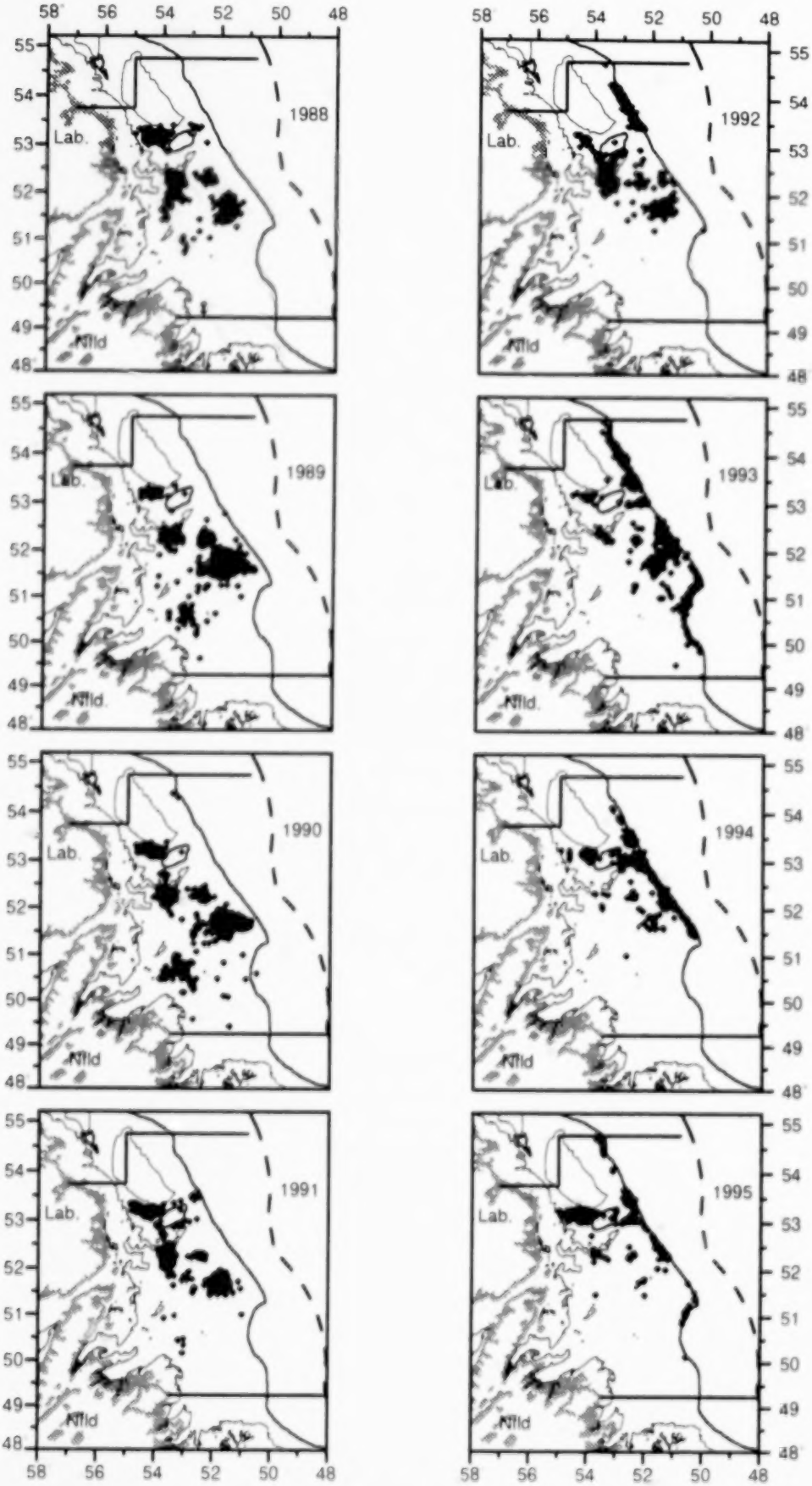


Fig. 6. Survey set distribution and catch indicies from offshore research, October 1995- January 1996.